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EVALUATION OF EFFECTS OF FIVE ORTHODONTIC  
ADHESIVES IN CLINICAL APPLICATIONS AND  
RELATED NURSING OPERATIONS

by

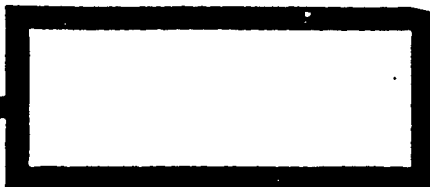
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EVALUATION OF EFFECTS OF FIVE ORTHODONTIC  
ADHESIVES IN CLINICAL APPLICATIONS AND  
RELATED NURSING OPERATIONS

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Abstract: By comparing the effects of five orthodontic adhesives in clinical applications and the effect of related nursing method on their performance, the authors found that the EB-type compound resin and the EM-type enamel adhesive are strongly affected by the nursing operation and temperature, with many factors affecting their setting. In addition, the support braces were found from clinical investigations to have a higher drop-out rate; therefore, the foregoing two adhesives proved to be ineffective in clinical applications.

It is understood that photostetting adhesives are still in the research stage and have yet to be commercialized; thus, this kind of adhesive needs to be further studied. The performance index and clinical effects of the Beijing/Tianjing enamel adhesive and the CC-1 type orthodontic adhesive have been shown to be superior over those of the other three adhesives. They, with reliable performance and simple nursing operations,

are believed to be ideal adhesives to be applied in orthodontic therapy.

In modern orthodontic therapy, with the introduction and extensive application of the fixing orthodontic technique, orthodontic adhesives have played a growing role in clinical applications. With the growing development of dental cementation technique, the adhesives have faced higher requirements from clinical physicians, i.e., they are not only required to be excellent in adhesiveness and physical performance with fewer factors that may affect adhesiveness, but also expected to be simple and labor-saving in clinical applications.

At present, a variety of orthodontic adhesives has been applied in clinical applications, such as powder-liquid type, dual paste type, single resin, compound resin, optically solidified adhesive, as well as radiosetting adhesive, etc.

Since the fixing orthodontic technique began to be widely applied at the orthodontics department in our institute in 1988, the EB-type compound resin adhesive, EM-type enamel adhesive, Beijing/Tianjing enamel adhesive, CC-1 orthodontic adhesive and photosetting adhesive, respectively, have been used in clinical applications. In the meantime, observations and comparative studies were conducted on the effects of the above mentioned five orthodontic adhesives in clinical applications as well as the effect of the related nursing operation on their performance as follows:

## Materials and Techniques

### 1. Materials

The materials include EB-compound resin, EM-type enamel adhesive, Beijing/Tianjing enamel adhesive, CC-1 orthodontic

adhesive and photosetting adhesive.

## 2. Techniques

A total of 85 cases was selected at random with reference to clinical malocclusion, for which fixing orthodontic therapy was conducted. Among them, 38 were male patients and 47 were female patients; their age ranged from 12 to 25. Also, 50 patients were treated with a square thread bow, while 35 patients were treated with the Begg technique. In the treatment, 1530 support braces were set, with a total drop-out rate of 364.

## Results

The drop-out rate of support braces set with the foregoing five orthodontic adhesives is shown in Table 1.

TABLE 1. Comparison of Drop-out rate of Support Braces Set with Various Adhesives

粘 合 剂 <sub>1</sub>	粘 贴 托 槽 <sub>2</sub> (个)	脱 落 托 槽 <sub>3</sub> (个)	脱 落 率 <sub>4</sub> (%)
EB复合树脂 5	234	101	43.2
EM釉质粘合剂 6	144	31	21.5
京津釉质粘合剂 7	306	65	21.2
CC-1型正畸粘合剂 8	504	82	16.3
光固化粘合剂 9	306	85	27.8

KEY: 1 - adhesives 2 - support braces set  
(unit) 3 - support braces dropped (unit)  
4 - drop-out rate (%) 5 - EB-type compound  
resin 6 - EM-type enamel adhesive  
7 - Beijing/Tianjing enamel adhesive  
8 - CC-1 type orthodontic adhesive  
9 - photosetting adhesive

It can be seen from Table 1 that the drop-out rate of support braces set with EB-type compound resin is 43.2%, which ranks the first among the five kinds of adhesives. While the drop-out rate of support braces set with the EM enamel adhesive and Beijing/Tianjing enamel adhesive is somewhat close, i.e., 21.5% and 21.2%, respectively. The drop-out rate of support

braces set with the CC-1 type orthodontic adhesive is 16.3%, which is the lowest drop-out rate. The drop-out rate of support braces set with the optically solidified adhesive is 27.8%.

## Discussion

### 1. Comparison of Physical Performance Among the Five Kinds of Orthodontic Adhesives (TABLE 2)

In view of physical performance of the five orthodontic adhesives, the physical performance of CC-1 type orthodontic adhesive and Beijing/Tianjing enamel adhesive are fairly close. The physical performance of the EM type enamel adhesive is also better, with a shearing stress 20.9mPa as the best, but it takes a longer time to set, i.e., 4.5min. All performance indexes of EB-type compound resin are relatively poor.

TABLE 2. Comparison of Physical Performance of the Five Adhesives

1 材 料	2 结固时间 (min)	3 表面硬度 (mPa)	4 压缩强度 (mPa)	5 剪切强度 (mPa)
EB复合树脂 6	3.5	2.49	153.7	11.9
EM釉质粘合剂 7	4.5	3.25	167.2	20.9
京津釉质粘合剂 8	1.5	3.60	171.8	14.5
CC-1型正畸粘合剂 9	1.4	4.57	168.3	14.8
光固化粘合剂 10	0.5	—	—	16.8

KEY: 1 - materials 2 - cementation time (min)  
 3 - surface hardness (mPa) 4 - compression strength (mPa) 5 - shear stress (mPa)  
 6 - EB-type compound resin 7 - EM enamel adhesive  
 8 - Beijing/Tianjing enamel adhesive  
 9 - CC-1 type orthodontic adhesive  
 10 - photosetting adhesive

### 2. Effect of Nursing Operation on Adhesive Performance

A proper nursing method is the key to the success in setting support braces. Therefore, nurses are required to familiarize

themselves with the constituents, performance, cementation time, spatula proportions, and the correct way of operating the five adhesives.

1. The EB-type compound resin and EM type enamel adhesive both belong to the powder-liquid type, featuring a long cementation time. Therefore, during the clinical nursing operation, nurses usually spatulate one batch at a time, and then use this adhesive to set a number of support braces. But when they come to the last several support braces, the adhesive has become semi-set, which affects the performance of the adhesive and its setting effect.

In addition, the cementation time of this powder-liquid type adhesive is susceptible to the effect of temperature variation. As a result, nurses are usually inclined to make an adjustment over the cementation time by modifying the proportions of the powder and liquid, but this, on the contrary, will damage the physical performance of the adhesive.

2. The Beijing/Tianjing enamel adhesive and CC-1 orthodontic adhesive are classified as dual paste type orthodontic adhesives; their proportions, dosage, and spatula method are all easily controlled and carried out during the clinical operation. The cementation time of the CC-1 type orthodontic adhesive can be adjusted by modifying the proportions of the dual ingredients. In this case, the nursing operation has little effect on the physical performance.

The photostetting adhesive allows ample time for the nursing operation and rapid setting. Hence there is sufficient time for clinical nursing operation, and the nursing operation has little effect on the physical performance.



### 3. Comparison of Clinical Effects of the Five Kinds of Orthodontic Adhesives in Clinical Applications

#### 1. EB-type Compound Resin

The EB-type compound resin is a powder-liquid type. Its cementation time is 3.5min as shown in Fig. 2, while its other physical performance indexes are all less than those of the remaining four adhesives. A total of 234 clinical cases was investigated, in which the EB-type compound resin adhesive was used to set support braces with 101 drops, the drop-out rate being 43.2%. This drop-out rate ranks first among the five adhesives. In addition, with this adhesive, the nursing operation is affected by many factors, including the temperature change and spatula proportions. Therefore, it is not ideal for clinical application.

#### 2. EM-Type Enamel Adhesive

All physical performance indexes of the EM enamel adhesive are relatively good except for its cementation time which is the longest, i.e., 4.5min. Of the 144 cases investigated, in which this adhesive was applied in setting support braces, there are 31 drops, accounting for a drop-out rate of 21.5%. This adhesive is also a powder-liquid type and similarly, its clinical nursing operation is subject to temperature change, and spatula proportions. Besides, the cementation time is slightly too long, which brings certain difficulties to clinical doctors, and also to child patients who cannot tolerate long setting periods, and whose saliva has a direct effect on the adhesive strength.

#### 3. Beijing/Tianjing Enamel Adhesive

The Beijing/Tianjing enamel adhesive is a new dual paste orthodontic adhesive. As Table 2 indicates, its physical

performance indexes are fairly good. According to clinical investigations, this adhesive was employed in 306 cases to set braces, in 65 cases of which the braces dropped--a drop-out rate of 21.2%.

The Beijing/Tianjing enamel adhesive is a dual component paste adhesive. With this adhesive, the clinical nursing operation is simple, and the dosage and spatulation are easy to control. Best of all, it is less likely to be affected by temperature change and therefore, its reliable performance can be ensured. Thus, it can be regarded as an ideal adhesive.

#### 4. CC-1 Orthodontic Adhesive

The CC-1 orthodontic adhesive is a dual paste orthodontic adhesive that was developed by our institute in recent years. The physical performance indexes of this adhesive are as good as those of the Beijing/Tianjing enamel adhesive. The clinical investigation suggests that 504 cases were treated with CC-1 type orthodontic adhesive used to set support braces, in 82 cases of which the braces dropped out, the drop-out rate being 16.3%. This figure was the lowest of the five.

The major advantage of this adhesive is that its cementation time can be self-adjusted with the variation of the environmental temperature. While the change of the dual paste proportions will not exert any effect on its physical performance (as shown in Table 3). As a result, the nurses can have enough time to position the support brace properly so as to enhance its accuracy and adhesiveness.

TABLE 3. Relationship Between the Operation Time and Cementation Time of CC-1 Type Orthodontic Adhesive Dual Paste Proportions

1	糊剂A/B	2 操作时间(s)	3 结固时间(s)
	1/1	100	150
	2/1	190	290
	1/2	60	100

KEY: 1 - paste A/B 2 - operation time (s)  
3 - cementation time (s) 5 - photosetting adhesive

The photosetting type setting and fixation technique used in stomatological orthodontics is a newly emerging technique, developed in the last decade. Compared with the conventional chemosetting orthodontic adhesive, it has its own advantages, as follows:

#### 1. Rapid Setting

Usually, the cementation time of chemosetting material is 2-5min, while the cementation time of photosetting adhesive is only 20-30s. Obviously, with the latter, the clinical operating efficiency can be significantly increased.

#### 2. Adequate Time for Operation

Normally, the chemosetting material can immediately become active as soon as it is spatulated. While this adhesive will not set until exposed to visible light, which ensures a sufficient time for the clinical nursing operation.

However, experiment shows that this adhesive has a major disadvantage, i.e., its adhesive strength is not as good as that of the chemosetting agent. In this case, since most orthodontic support braces are made of metal, it suffers from a higher braces

drop-out rate, namely 27.8%, as confirmed by clinical statistics.

To summarize, from the physical performance, nursing operation as well as clinical observations of these five kinds of adhesives, the Beijing/Tianjing enamel adhesive and CC-1 orthodontic adhesive are apparently better than the rest of three.

With their reliable performance and easy nursing operation, they can be accepted as ideal adhesives in orthodontic therapy.

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